V. CLAIMS

We claim:

1. A process for decomposing waste plastic comprising the steps of:
   a. supplying waste plastic;
   b. mixing said waste plastic with a diluent to create a solution;
   c. controlling the content of said solution;
   d. heating said solution to a reactant temperature to substantially depolymerize the waste plastic; and
   e. collecting the by products of said depolymerization process.

2. A process for the recycling of waste plastic comprising:
   a. mixing said waste plastic with oil to form a mixture;
   b. heating said mixture in the presence of about 0.5% to 10% wt of a free radical initiator to between about 325 and 375°C for a period less then about one hour; and
   c. recovering hydrocarbon distillate as an overhead product and condensing and storing said distillate.

3. A process for decomposing waste plastic as described in claim 1 wherein said step of heating said solution to a reactant temperature to substantially depolymerize the waste plastic comprises the step of heating to less than about 400°C.

4. A process for decomposing waste plastic as described in claim 1 wherein said step of heating said solution to a reactant temperature to substantially depolymerize the waste plastic comprises the step of heating to about 375°C.

5. A process for decomposing waste plastic as described in claim 1, wherein said step of controlling the content of said solution comprises the step of adding a third substance to said process respective of said waste plastic and said oil.

6. A process for decomposing waste plastic as described in claim 1 wherein said step of controlling the content of said solution comprises the step of controlling free radical precursor of said solution.

7. A process for decomposing waste plastic as described in claim 6 wherein said step of controlling free radical precursor of said solution comprises the step of adding a waste plastic material to said process.

8. A process for decomposing waste plastic as described in claim 6 wherein said step of controlling free radical precursor of said solution comprises the step of adding a substance chosen from a group consisting of polyvinyl chloride and polyurethane.

9. A process for decomposing waste plastic as described in claim 1 wherein said step of controlling the content of said solution comprises the step of sensing the relative amount of free radicals likely to be present in said solution after it is heated.

10. A process for decomposing waste plastic as described in claim 9 wherein said step of sensing the relative amount of free radicals likely to be present in said solution after it is heated comprises the step of ascertaining the reactant temperature of said solution.

11. A process for decomposing waste plastic as described in claim 1 and further comprising the step of recycling a portion of said diluent.

12. A process for decomposing waste plastic as described in claim 1 and further comprising the step of recycling from 0 to 95% of said diluent.

13. A process for decomposing waste plastic as described in claim 11 wherein said step of recycling a proportion of said diluent comprises the step of recycling from 70% to 90% of said diluent.

14. A process for decomposing waste plastic as described in claim 1 wherein said step of mixing said waste plastic with a diluent to create a solution comprises the step of mixing said waste plastic with an oil.

15. A process for decomposing waste plastic as described in claim 1 wherein said step of mixing said waste plastic with a diluent to create a solution comprises the step of mixing said waste plastic with a heavy oil.

16. A process for decomposing waste plastic as described in claim 1 wherein said step of mixing said waste plastic with a diluent to create a solution comprises the step of mixing said waste plastic with a low value oil.

17. A system for decomposing waste plastic comprising:

a. a first, second, and third supply means;

b. a mix means responsive to at least two of said supply means;

c. a reaction container connected to said mix means and responsive to said third supply means;

d. a temperature control means connected to said reaction container;

e. a collection means connected to said reaction container; and

f. a control means wherein said third supply means is responsive to said control means.

18. A system for decomposing waste plastic as described in claim 17 wherein said first supply means supplies waste plastic and wherein said second supply means supplies a diluent.

19. A system for decomposing waste plastic as described in claim 18 wherein said second supply means supplies an oil.

20. A system for decomposing waste plastic as described in claim 19 wherein said second supply means supplies an oil selected from waste motor oil, fluidized catalytic cracker slurry oil, distillation tower vacuum bottoms, heavy heating or bunker oil, or combinations thereof.

21. A system for decomposing waste plastic as described in claim 17 wherein said temperature control means achieves temperatures of no more than 400°C.

22. A system for decomposing waste plastic as described in claim 20 wherein said control means is responsive to the temperature within said reaction container.

23. A process for decomposing waste plastic as described in claim 1, wherein said step of controlling the content of said solution comprises controlling the free radical content of said solution.

24. A process for decomposing waste plastic as described in claim 1, wherein said step of controlling the free radical content comprises controlling the free radical content to substantially depolymerize said waste plastic.

25. A process for the recycling of waste plastic as described in claim 2, wherein said waste plastic comprises comminuted waste plastic selected from the group consisting of: polyethylene, polypropylene, polystyrene, nylon-66, polyurethane, polyethylene terephthalate, polyvinyl chloride resin, and combinations thereof.

26. A process for the recycling of waste plastic as described in claims 19, wherein said oil comprises oil selected from the group consisting of: waste motor oil, FCC slurry oil,

vacuum distillation tower bottoms, fluidized catalytic cracker slurry oil, heavy heating oil, bunker oil, and combinations thereof.

27. A process for the recycling of waste plastic as described in claim 1 wherein the free radical initiator comprises a separate catalyst precursor added to said waste plastic and/or said oil.

28. A process for the recycling of waste plastic as described in claim 1 wherein said waste plastic includes polyvinyl chloride and no separate free radical catalyst precursor is employed.

29. A process for the recycling of waste plastic as described in claim 20 wherein said waste plastic dissolves in said oil.

30. A process for the recycling of waste plastic as described in claim 20 wherein the distillate comprises a distillate selected from the group consisting of toluene, styrene, and combinations thereof.

31. A process for the recycling of waste plastic as described in claim 20 wherein additional free radical initiator is introduced in response to a decrease in distillate yield or increase in temperature.

32. A process for the recycling of waste plastic as described in claim 20 wherein said overhead further comprises non-condensible gas and normally-solid speciality substances.

33. A process for the recycling of waste plastic as described in claims 23-26, wherein oil containing dissolved waste plastic is recycled to a reactor.